

SUMMARY

Title: New SCR Catalysts for U.S. Coals

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The majority of catalysts used for NO_x selective catalytic reduction (SCR) are vanadia/titania catalysts. The limited life of these catalysts arise from their main constituents - vanadium and titanium based compounds which are prone to the poisoning effect caused by arsenic, alkali and alkaline earth compounds produced during the combustion of coal. Vanadium compounds also promote SO₃ formation thereby increasing the corrosion potential of downstream components. In addition to their cost, the spent catalysts pose environmental hazards and require special care for disposal. In a majority of cases, spent catalysts are returned to the catalyst supplier for disposal. In some States, the spent SCR catalyst is designated to be a hazardous substance.

A catalyst which offers improved resistance to poisoning by the constituents at levels present in US coals, poses no environmental hazard for disposal, requires less space for retrofit and is cost competitive would offer significant advantages in terms of both capital and operating costs of SCR installations. These are the goals of a series of catalysts based on copper oxide on alumina.

A series of catalysts, using a promoted copper oxide on alumina, prepared using Apyron Technology's patented co-particle technology, have been developed. A flow reactor system was constructed to allow the study of small amounts of catalyst (5 g) during exposure to NO, NH₃, O₂, and SO₂. Typical reaction conditions include a space velocity of 3,900 hr⁻¹ and concentrations of NO, NH₃, O₂ of 500 ppm, 500 ppm, and 2.5%, respectively, with the balance being helium. Bench scale tests at temperatures from 200 to 450 °C have shown greater than 70% NO_x removal (greater than 90% removal from 225 – 450 °C) with less than 5 ppm ammonia slip, a significant improvement over the unpromoted material. The unpromoted material shows a dramatic fall-off in activity at temperatures below 250 °C. These promoted catalysts also show no detrimental effects from being exposed to SO₂ and O₂, even to the extent of being completely sulfated, except for a very slight loss in low temperature activity.

For those applications involving simultaneous SO₂ and NO_x reductions, these materials show excellent SO₂ adsorption capacity and adsorption kinetics. Experiments measuring the SO₂ adsorption capacity were carried out in a Cahn TG-151 TGA. The materials were first regenerated in methane at 500 °C for 15 minutes, then cooled in nitrogen, followed by exposure to a flowing mixture (200 cm³/min) of SO₂ (3,000 ppm) and O₂ (2%) in helium at 150 °C. For

short exposure times (30 min. – 1 hour), the promoted materials show a sulfur dioxide uptake that is double that of the unpromoted material. Subsequent exposure to methane and heating to 500 °C resulted in virtually instantaneous and complete recovery of the adsorption capacity. Even after 13 adsorption/regeneration cycles, involving several to near-saturation, the materials showed no loss of adsorption capacity after regeneration.

The presentation will describe the details of the testing, the experimental results obtained and the current status our efforts.